2023

2023

Du Mont

Cathode-ray Oscillograph

TYPE 279

OPERATING AND MAINTENANCE MANUAL

Allen B. Du Mont Laboratories, Inc.

CLIFTON, NEW JERSEY

Obviously, the design of any piece of electrical indicating equipment resolves from a series of compromises which represent the designer's opinion of an ideal instrument consistent with contemporary engineering techniques and present-day production possibilities.

In developing this instrument, an attempt has been made to incorporate circuits the characteristic of which, we believe, will satisfy the greatest number of applications, and to this end many circuit combinations have been included to extend its flexibility and versatility.

We feel, however, that the real test of any instrument is the opinion of the man who uses it. This day-to-day test of the instrument's advantages and limitations will prove, more than any other method, just what characteristics are desirable, why the range of any given component or function of the equipment should be extended, and how important such modification is.

Because of the nature of the equipment manufactured by Allen B. Du Mont Laboratories, Inc., it is only by complete cooperation between the customer and our Engineering Department that satisfactory designs can be achieved. In an attempt to continually extend the applicability of our equipment to the problems of the engineer, we sincerely request suggestions advising in what manner the design of this equipment may be further extended to include these problems.

OPERATING AND MAINTENANCE MANUAL

FOR THE

DU MONT TYPE 279 CATHODE-RAY OSCILLOGRAPH

ALLEN B. DU MONT LABORATORIES, INC.
INSTRUMENT DIVISION
1000 MAIN AVENUE, CLIFTON, N. J., U. S. A.

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FIGURE 1-1
THE DU MONT TYPE 279 DUAL-BEAM CATHODE-RAY OSCILLOGRAPH

SECTION I
GENERAL DESCRIPTION

1. PURPOSE.

The Du Mont Type 279 Dual-beam Cathode-ray Oscillograph has been designed as a general-purpose dual-channel instrument. It uses the Du Mont Type 5SP- Dual-beam Cathode-ray Tube. Since the cathode-ray tube is an indicator having negligible inertia, it may be used at much higher frequencies than a meter or string oscillograph, while the use of direct-coupled amplifiers permit its use also at low frequencies. The Type 279 is well suited to comparison of two waveforms on the same or independent time scales. Phase, amplitude, and frequency relationships are easily measured, and an expanded presentation of the initial portion of many types of signals can be viewed simultaneously with the entire waveform.

2. DESCRIPTION.

The Type 279 Dual-beam Cathode-ray Oscillograph is housed in a gray-wrinkle, rack-type cabinet equipped with carrying handles on each side. A standard relay-rack panel is used so that the instrument may be removed from its cabinet and mounted in a standard relay rack. A dust cover is available for rack mounting.

The instrument utilizes the Type 5SP- Dual-beam Cathode-ray Tube operated at a total accelerating potential of 4500 volts, producing a pattern of high brightness. Each beam is provided with separate controls for intensity, focus, and X- and Y-position.

Balanced, deflection amplifiers are used for both X- and Y-deflection systems and are identical except for sensitivity and position equalizing circuits. The response of the Y amplifiers is flat to direct current at the low end and is down 3 db. at 200 kc. The X amplifiers are flat to d-c at the low end and are down 3 db. at 110 kc. The deflection factor of all amplifiers is not more than 0.35 rms V/in. (1 d-c V/in.). Compensated stepped-type attenuators precede each amplifier. A built-in voltage calibrator can be switched into either Y amplifier at any time. Capacitively-coupled connections direct to the deflection plates may be made through terminals located at the rear of the instrument.

Z-axis connections to the cathodes of the cathode-ray tube may be made through the input terminals located in the rear to permit intensity modulation. There are no Z-axis amplifiers.

Identical linear time-bases are provided for each beam. These consist of gas-triode sweep generators having continuous sweep frequencies between 2 and 30,000 cps. Single sweep is also available with automatic beam control so that the spot is extinguished except during active sweep time. This feature, along with the high brightness and long persistence that may be obtained when using a Type 5SP2 tube, makes the instrument ideally suited for photographic work or observation of single transients with relatively high writing rates.

Provision is made to apply signals from one of the time-base generators to both sets of horizontal deflection plates simultaneously to facilitate the study and comparison of related phenomena on the same time base. Correction circuits in the instrument allow superposition of both time-base traces for this type of operation.

A power source of either 115 or 230 volts ±10%, 50-60 cycles, is required to operate the instrument. The power consumption is 300 watts.

The overall dimensions are 21-3/4″ wide by 17″ high by 22-1/4″ deep. The unit weighs 125 lbs.

TABLE 1-1
ELECTRICAL CHARACTERISTICS

Cathode-ray Tube

Type	5SP- Dual-beam Cathode-ray Tube
Total Accelerating Potential	4500 volts

Input Circuits

X- and Y-axis Amplifiers

Input Coupling	Capacitive or conductive
Attenuators	1:1, 10:1, 100:1 stepped, 10:1 variable
Impedance	2 megohms, 60 μμf.

Direct to Deflection Plates

Input Coupling	Capacitive only
Impedance—Single-ended	1 megohm, 20 μμf.
Balanced	2 megohms, 20 μμf.

Z-axis

Input Coupling ..... Capacitor to CRT cathode

Polarity ..... Positive signal decreases intensity

Impedance ..... 10,000 ohms, 40 μμf.

Amplifiers

Response

No positive slope above 1000 cycles.

	SINE WAVE		*SQUARE WAVE*
Low-frequency (all amplifiers)			
Capacitive Input	1 db. @ 10 cps		15% saw @ 10 cps
Direct Input	Flat to D.C.		.....
High-frequency	*1 db. @*	*3 db. @*	*No Distortion @*
Y-axes	100 KC	200 KC	20 KC
X-axes (Individual)	50 KC	110 KC	10 KC
X-axis (A-common)	30 KC	60 KC	5 KC

Deflection Factor

Through Amplifiers ..... Not more than 0.35 rms V or 1 D-C V/in.

Direct to X-plates ..... 25 rms V or 69 D-C V/in. ±20%

Direct to Y-plates ..... 29 rms V or 80 D-C V/in. ±20%

Linear Time-base

Frequency Range ..... 2-30,000 sawtooth cps

Sweep Recurrence ..... Single or continuous

Common Sweep ..... Provision made for Sweep A to deflect both beams simultaneously with correction to allow superposition of time-base traces

Blanking

Continuous Sweep ..... Return trace blanked

Single Sweep ..... Beam on only during sweep

Sweep Output ..... Sweep A at front panel terminal

Sync Circuits

Signal Sources ..... Internal (Y-axis), External, or power line frequency

Polarity of Sync Signal Usable ..... Positive or negative

Voltage Calibrator

Availability ..... Either Y-axis through input attenuator but not simultaneously

Voltage ..... 0.1, 1, 10, 100 volts ±5%

Waveform ..... Square-wave at line frequency

Miscellaneous

Test Signals Available at

Front Panel ..... Filtered sine wave at power line frequency
Sawtooth waveform from Channel A

Positioning ..... Available at all times

Front Panel ..... Relay-rack type

Power Source

Voltage ..... 115/230 volts rms ±10%

Frequency ..... 50-60 cycles

Power Consumption ..... 300 watts

Fuse Protection ..... 3 amperes

Mechanical

Size ..... 17″ high x 21-3/4″ wide x 22-1/4″ deep

Weight

Without Cabinet ..... 86 lbs.

With Cabinet ..... 125 lbs.

Mounting ..... Cabinet or relay rack

SECTION II
THEORY OF OPERATION

1. GENERAL.

A block diagram of the Type 279 is shown in Figure 2-1 and the schematic of the circuit at the back of the book. These circuits will be discussed in the following sections. The two guns and their beam circuits are referred to as Beam A and Beam B, and the associated signal deflection circuits are referred to as Channel A and Channel B, respectively.

2. CATHODE-RAY TUBE AND BEAM CIRCUITS.

The cathode-ray tube and beam circuits are shown in Figure 2-2. The cathode-ray tube is the Type 5SP-5-inch Dual-beam Cathode-ray Tube. It is operated at a total accelerating potential of 4500 volts, with the intensifier operated at a potential of +3000 volts and the cathodes at potentials of –1500 volts with respect to chassis. The second anode connections are not

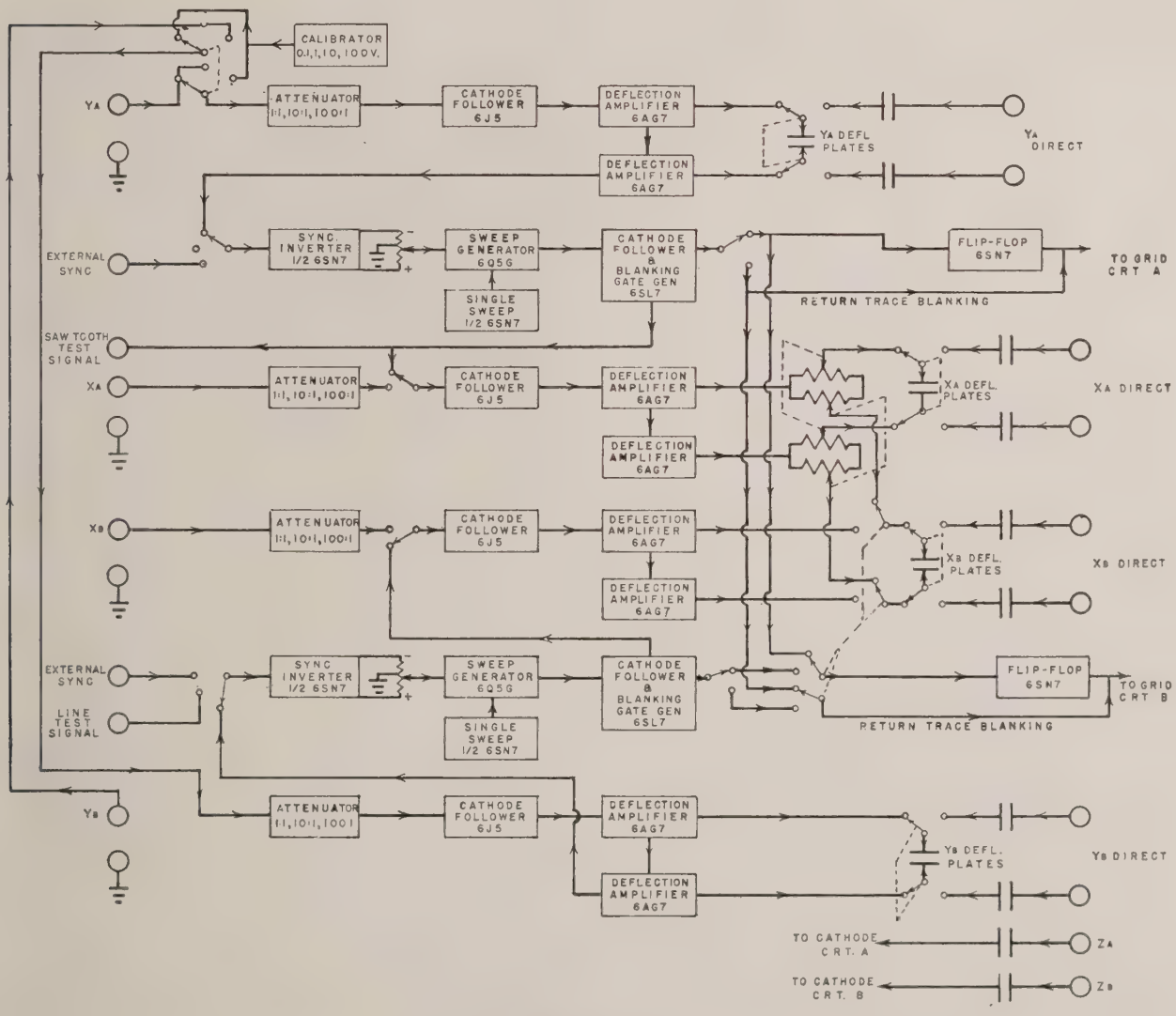


FIGURE 2-1
BLOCK DIAGRAM OF THE DU MONT TYPE 279 DUAL-BEAM CATHODE-RAY OSCILLOGRAPH

Ref. Dwg. XC-930. Issue 4

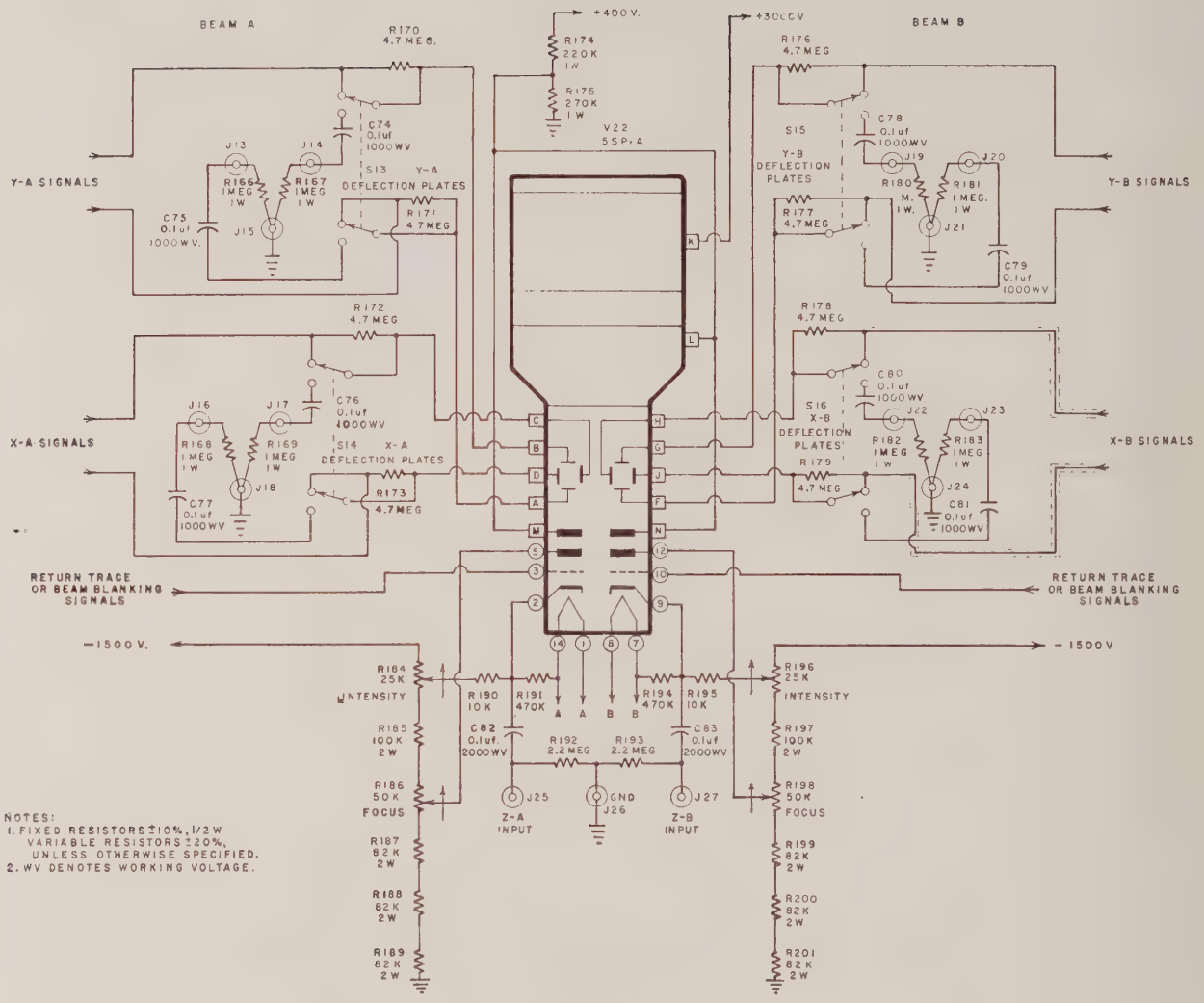


FIGURE 2-2
CIRCUITS OF THE CATHODE-RAY TUBE OF THE DU MONT TYPE 279 DUAL-BEAM CATHODE-RAY OSCILLOGRAPH

Ref. Dwg. XC-1003. Issue 2

grounded but are operated at the deflection-amplifier static plate potentials of approximately +220 volts. The deflection plates are connected directly to the plates of the deflection amplifiers.

In order to provide exact superposition of both time-base traces, it is necessary that deflection sensitivity, position, and angular alignment of the two traces be the same. The angular alignment is limited by tolerances in manufacture of the cathode-ray tube. The undeflected position of the two spots is also limited by tube manufacture. This is adjustable by circuits, however, and its adjustment is discussed in one of the succeeding sections.

By using the same amplifier to feed the sweep to both sets of deflection plates for the common sweep, variations in performance of separate amplifiers (such as phase shift, amplifier gain, etc.) are avoided. The signal being fed to both sets of deflection plates will therefore be identical, and the only correction that must be made is for differences in deflection sensitivity of both sets of plates. Since deflection sensitivity is dependent on accelerating voltage, correction is made by small variations of the accelerating potential of one gun with respect to the other. This is accomplished as shown in Figure 2-3 and consists of a dual potentiometer, one section connected as a variable resistance in the filter supplying one of the beams, and the other section similarly connected in the other high

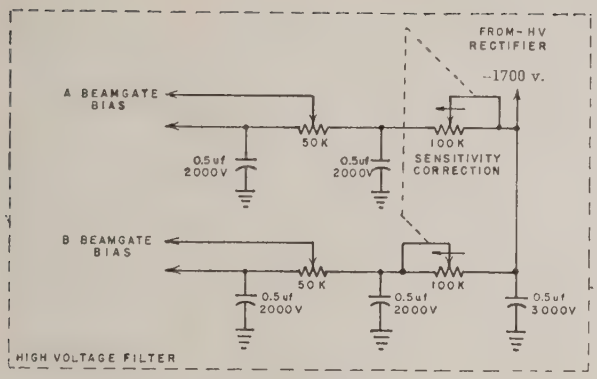


FIGURE 2-3

HIGH-VOLTAGE FILTER

Reg. Dwg. XC-1003. Issue 2

voltage filter circuit. As one is increased to lower the accelerating voltage of one beam, the other is decreased to raise the accelerating voltage of the other beam.

Each gun has its own filter and bleeder network, giving independent adjustment of intensity and focus. In order to minimize cross-coupling through the guns, separate heater windings are provided for each cathode-ray tube heater.

Beam control and return-trace blanking signals are fed to the grids of the cathode-ray tube, and Z-axis signals to the cathodes, so that a positive, external signal is required for blanking.

3. AMPLIFIERS (c.f. Figure 2-4).

Four amplifier systems are provided which are identical with the exception of the position-correction circuit of the A channel X-axis amplifier (described below) and the values of the peaking coils. These consist of input attenuators, input cathode-followers, and self-balancing paraphase deflection amplifiers.

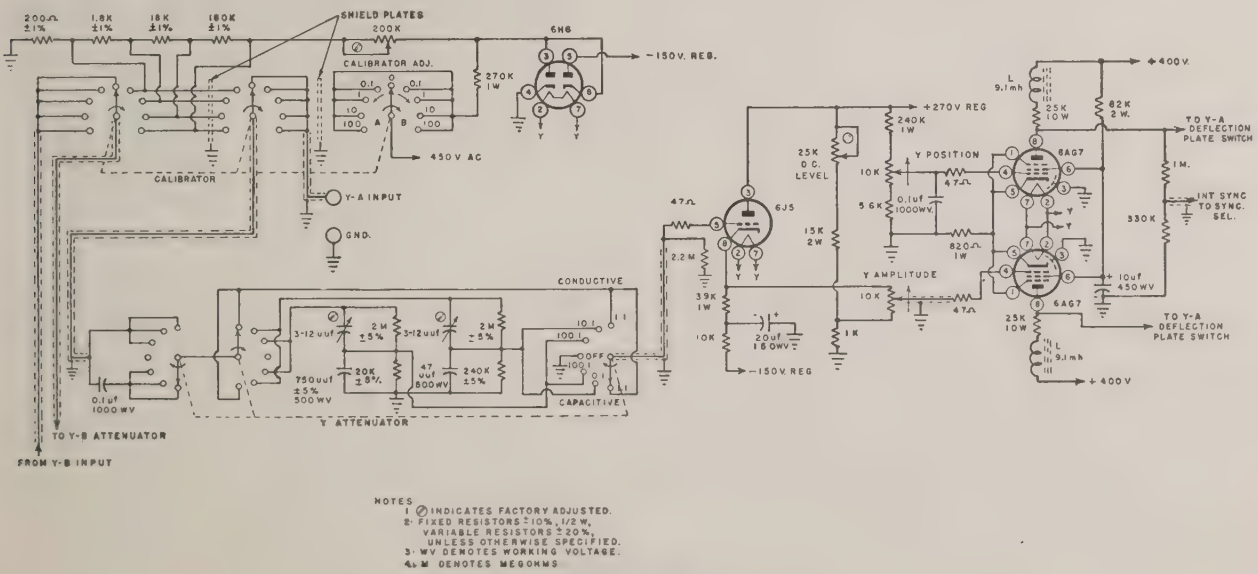
a. INPUT ATTENUATORS.

The input attenuators are connected to the input terminals, either directly or through a blocking capacitor. In the Y-axis, this connection is made through a switch to allow either the calibrator output or Y-input signal to be fed through the attenuator to the amplifier.

The stepped attenuators are resistance-capacitance compensated and have attenuation ratios of 1:1, 10:1, and 100:1. The switch is a seven-position switch, the center position of which is an off-position and grounds the input of the first tube. This prevents any input signal from coupling to the deflection plates when direct deflection is used. It also provides a convenient means of grounding the input of the amplifier without necessitating removal of the signal leads. Capacitive input connections are on the three positions to the left of the off-position and conductive on the three to the right. Maximum attenuation in each case is on the position adjoining the off-position.

b. CATHODE-FOLLOWER.

The input cathode-follower employs a 6J5 triode with the plate connected to the regulated supply. The cathode is returned to a –150 volt regulated supply to permit enough signal voltage range at minimum settings of the gain control without on-screen overload.



NOTES
1. ⊘ INDICATES FACTORY ADJUSTED.
2. FIXED RESISTORS ±10%, 1/2 W, VARIABLE RESISTORS ±20%, UNLESS OTHERWISE SPECIFIED.
3. WV DENOTES WORKING VOLTAGE.
4. M DENOTES MEGOHMS

FIGURE 2-4

VOLTAGE CALIBRATOR AND Y-AXIS AMPLIFIER CIRCUIT

Ref. Dwg. XC-1002. Issue 3

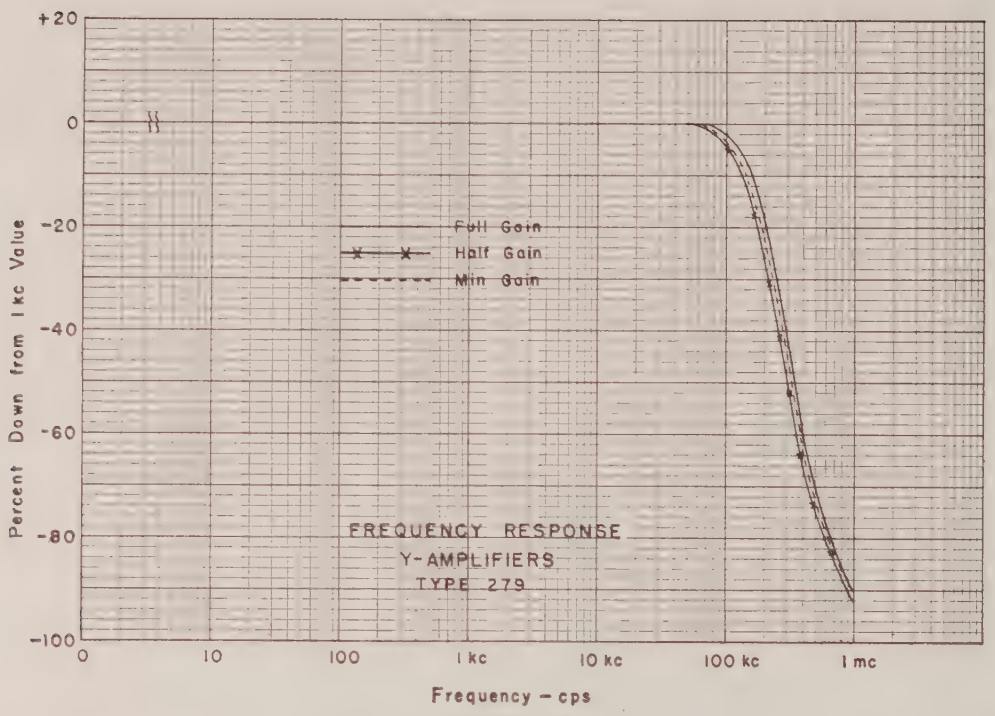


FIGURE 2-5

Y-AXIS FREQUENCY RESPONSE CURVES OF THE DU MONT TYPE 279 DUAL-BEAM CATHODE-RAY OSCILLOGRAPH

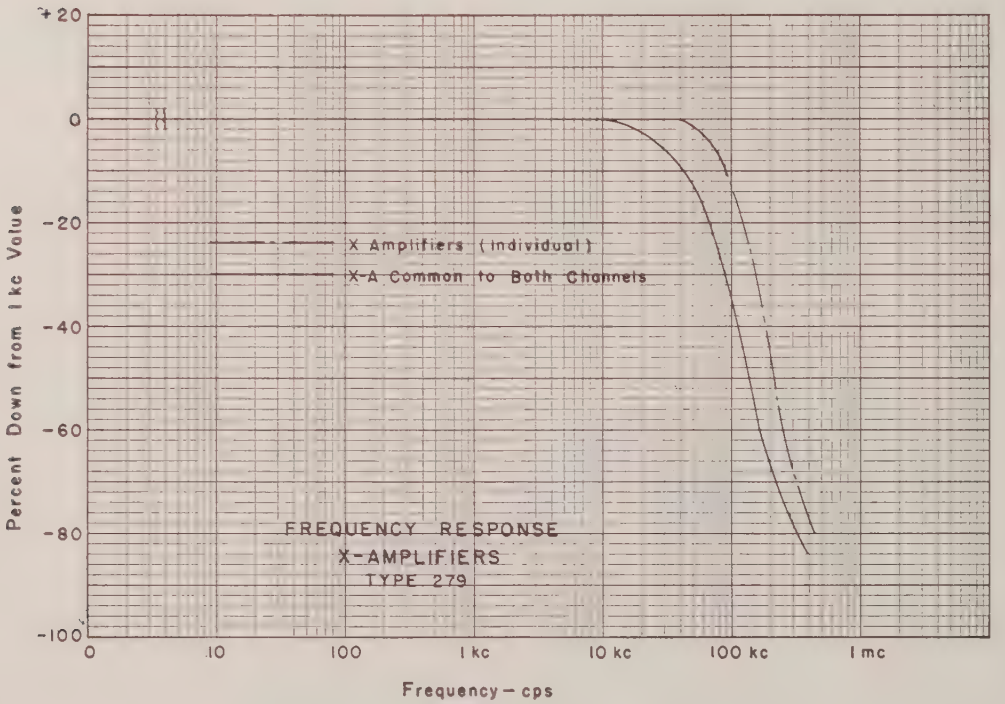


FIGURE 2-6

X-AXIS FREQUENCY RESPONSE CURVES OF THE DU MONT TYPE 279 DUAL-BEAM CATHODE-RAY OSCILLOGRAPH

c. DEFLECTION AMPLIFIER.

The output of the cathode-follower is directly connected to one side of the gain control, the other side of which is connected to a bleeder which can be adjusted to balance out the DC component due to the bias of the cathode-follower. This permits variation of the gain control without depositioning the beam. The arm of the gain control is connected through a 47 ohm oscillation suppressor to the grid of one of the 6AG7 deflection amplifier tubes. The cathode-coupled self-balancing phase inverter is of conventional design employing shunt peaking in the plate circuits. DC positioning is introduced to the grid of the second 6AG7.

The output of the deflection amplifier is connected directly to the deflection plates through a toggle switch located at the rear of the instrument. The other position of the toggle switch connects the deflection plates to rear terminals through 0.1 μf. capacitors. Positioning is available when direct connection to the deflection plates is used. 1 megohm discharge resistors are connected from the input terminals to ground.

All input capacitors have a rating of 1000 volts except the Z-axis input capacitors, which have a 2000 volt rating.

The deflection factor of all amplifiers is no more than 0.35 rms volts (1 peak-to-peak or D-C volt) per inch.

With the input capacitor connected, amplifier response of the Y-axes is down not more than 1 db. (from the average value at 1 KC) from 10 cps to 100 KC and is down not more than 3 db. at 200 KC. There is no positive slope above 1 KC. With direct coupling, the response at the low end is flat to DC.

Due to the switching necessary to obtain either individual or common sweeps, the frequency response of the X-axis amplifiers is not as good as that of the Y. At the low end, the X-axis response is the same as that for the Y-axis. The response at the high-frequency end when the sweep selector switch is in the "Individual" position is down not more than 1 db. at 50 KC nor more than 3 db. at 110 KC.

With the sweep selector switch in the "Common" position, the X-axis response at the high-frequency end is down not more than 1 db. at 30 KC and not more than 3 db. at 60 KC.

The frequency response characteristics are shown in Figures 2-5 and 2-6. The amplifiers allow more than 5 inches of undistorted deflection at any setting of the amplitude controls, which have practically no frequency discrimination.

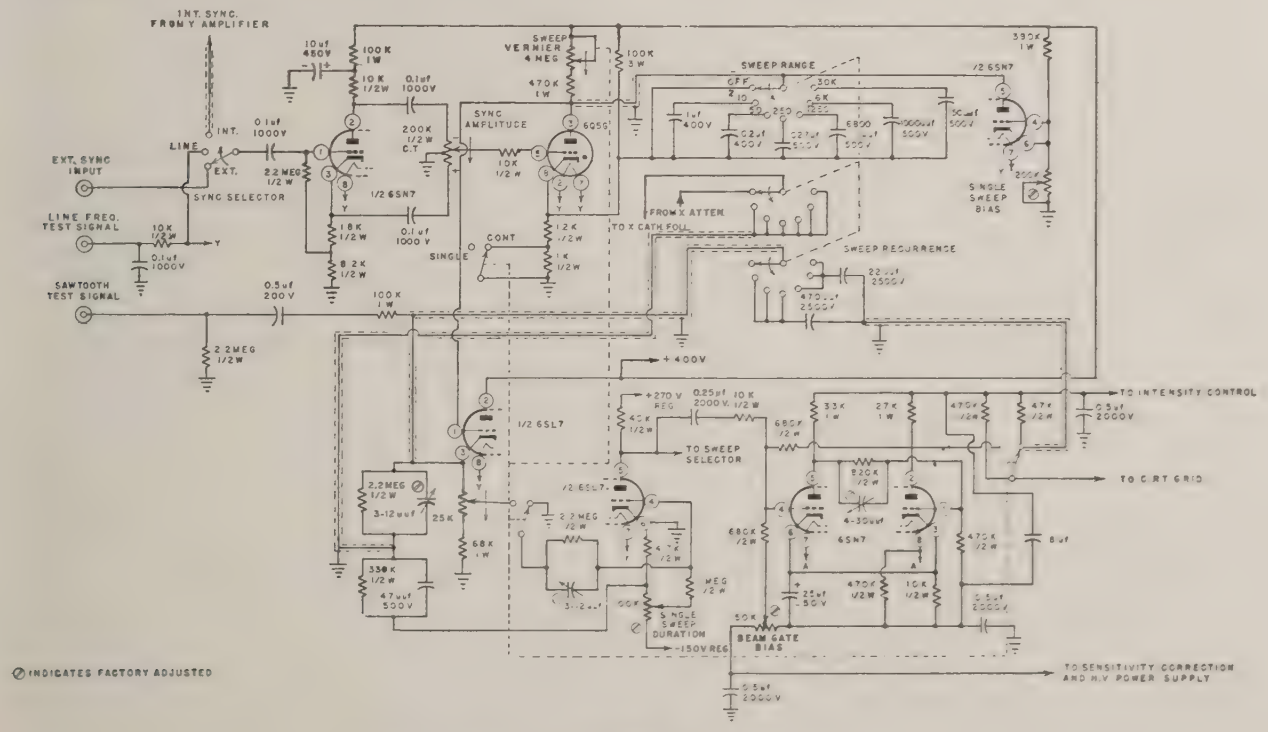


FIGURE 2-7
SWEEP AND BEAM CONTROL CIRCUITS

Ref. Dwg. XC-1004. Issue 3

4. LINEAR TIME-BASE (c.f.Figure 2-7).

Two identical linear time-base generators are provided. These use gas triodes (Du Mont Type 6Q5G) and have a continuous range of 2-30,000 cps in six overlapping steps. Either continuous or single sweep operation may be chosen.

Synchronization of the sweep may be obtained internally from the corresponding Y-axis amplifier, externally, or from the power line. Either polarity may be used. One-half of a 6SN7 is used for a sync phase selector, and the output from either the plate or cathode is fed to the grid of the 6Q5G through a center-tapped potentiometer.

The other half of the 6SN7 is diode-connected and used as a single-sweep diode. Its bias is adjusted so that the diode conducts just before the thyratron would fire. A sync signal introduced into the grid of the thyratron then lowers its breakdown potential below the diode conduction potential, and the tube fires.

The output of the sweep tube is then fed to a cathode-follower consisting of one-half of a 6SL7. The output of this cathode-follower is fed through an R-C compensated attenuator returned to the negative supply to bring the D-C level down to zero. The attenuated output is directly coupled to the input of the X-amplifier when using sweep.

An off position of the sweep switch connects the X-amplifier input terminal and attenuator to the X-amplifier.

The output of the sweep cathode-follower is also fed through a differentiating network to provide return-trace blanking and to a front panel terminal to provide a sawtooth test signal for sweep A. When common sweep is chosen, sweep B is automatically turned off.

For single sweep, the output of the sweep cathode-follower is also fed through an attenuator to the other half of the 6SL7. This output is taken from the moving arm of a specially-tapered potentiometer ganged to the sweep vernier to compensate for variation in sweep signal output of the cathode-follower with rotation of the sweep vernier.

This tube is biased by the setting of the single-sweep duration adjustment (R52 for channel A and R131 for channel B), Figures 3-2 and 3-3, so that it is conducting at some level near cut-off in the absence of a sweep signal. When the sweep is triggered, the fast negative-going return-trace pulse puts the grid substantially beyond cut-off, thus sending the plate up to B–. The grid then becomes less negative as the sawtooth (sweep) progresses until, near the end of the sweep, the tube begins to conduct again. The plate voltage then begins to drop until the sweep is over. The waveforms are shown in Figure 2-8.

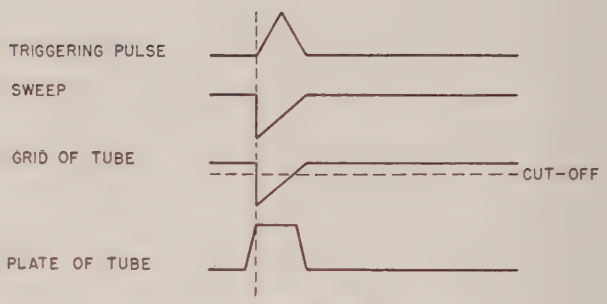


FIGURE 2-8
WAVEFORMS IN SINGLE SWEEP CIRCUIT

A 6SN7 (V8 for channel A, V18 for channel B) used in a flip-flop circuit with two stable operating points is triggered by the waveform produced in the plate of V7B (V17B for sweep B). This flip-flop circuit generates the intensifying gate which illuminates the screen of the cathode-ray tube during the single-sweep period and keeps the tube cut off at all other times.

This tube is in series with the cathode-ray tube bleeder and the high-voltage negative supply. The first half section is biased off by the Beam Gate Bias Control and the second half section is normally conducting. This holds the cathode-ray tube grid below cut-off. The positive gate from the plate of V7B turns V8A on and this in turn cuts off V8B in whose plate circuit a positive gate is hence generated and directly connected to the grid of the cathode-ray tube, turning the beam on. Since the beam gate circuit is directly coupled throughout, the gate will correspond in duration with the waveform fed into the first grid from the plate of V7B and will correspond to some 60 or 70% of the sweep cycle. This percentage is the active single-sweep trace.

The Beam Gate Bias and Single Sweep Duration controls must be correctly set to allow proper operation of this circuit (c.f. Figure 3-4). The Beam Gate Bias adjustment is made so that the cathode-ray tube beam is biased off during the resting time but allows adequate brilliance during the active sweep time. The Single Sweep Duration control is adjusted so that the circuits operate stably and so that the useful portion of the single sweep is linear. This is, in general, 60 to 70% of the total sweep time.

One of the important requirements of the Type 279 is the comparison of related phenomena on a common scale. This requires a time-base having the same sweep speed and amplitude on each channel and starting at the same point so that the two sweep lines may be superimposed exactly. Ideally this means that the

zero signal position of the beams should coincide at the screen and that the deflection factors of the two corresponding sets of plates be identical; and, in addition, these plates should be exactly parallel. These are rather rigid requirements for the tube so that certain tolerances have had to be established for these characteristics.

Actually, the tube specification calls for the spots produced from each gun to fall within a 25 millimeter square, the center of which is the center of the screen. This, therefore, requires a fixed adjustment in the oscillograph to correct for position of the undeflected beams.

In addition, tube specifications provide for deviation of the deflection factor of corresponding sets of deflection plates to be not more than 15%. A correction for sensitivity must then also be provided and has been discussed in Section II, paragraph 2.

In order to eliminate errors in spot tracking due to amplifiers and other circuits, the common sweep (Sweep A) is fed through the channel A X-axis amplifier, and the output of this amplifier applied to both sets of deflection plates. Position correction is accomplished by means of two sets of dual potentiometers connected in the plate circuits of the deflection amplifier as shown in Figure 2-9 (also see Figure 3-4).

By rotating either dual potentiometer, the DC potential on one set of deflection plates can be shifted without changing the total AC signal value. Hence, the pattern is shifted to the left or right by this change in DC level.

5. CALIBRATOR (c.f. Figure 2-4).

The calibrator consists of a 6H6 double-diode, one section of which is biased to conduct at ground potential and the other to conduct at –150 volts. A 450 volt rms sine wave of line frequency taken from the power transformer is fed to this diode and is clipped at 0 and –150 volts, giving essentially a square wave of 150 peak-to-peak volts at line frequency.

The output of the calibrator is fed through a resistance voltage-divider composed of 1% resistors, preceding which is a variable resistance adjustment to set the voltage (cf. Figure 3-4.) The output of the voltage divider gives voltages of 0.1 V, 1 V, 10 V, and 100 V ±5% which may be switched into either Y-axis channel through a nine-position selector switch. The center position of this switch is an "Off" position and connects both Y-input terminals to their respective input attenuators.

When the Calibrator switch is set to the left of the center position, the Y_A input terminal is disconnected from its input attenuator and the various calibrated voltages connected to the attenuator, the voltage increasing as the switch is rotated away from the center position. The same holds for the Y_B channel when the selector switch is turned to the right of the center position. Calibration voltage may not be fed to both channels simultaneously.

By inserting the calibrated voltage ahead of the input attenuators, calibration may be obtained for any desired gain setting of either Y-axis amplifier.

6. POWER SUPPLIES.

a. HIGH-VOLTAGE SUPPLIES.

The 3000 volt positive supply uses a 2X2 rectifier tube and is filtered only by a capacitor and bleeder. A current-limiting resistor in series with the output protects personnel against accidental contact with the intensifier lead.

The high-voltage negative supply uses a 3B24 in order to deliver the current necessary for operation of both cathode-ray tube guns, bleeders, and beam-control circuits. The output from the 3B24 is fed to an input filter capacitor and then to separate 2-section R-C filter circuits for each cathode-ray tube gun. The first resistors of each filter consist of a dual potentiometer which is used for sensitivity correction as explained above. The second resistors are individual potentiometers controlling the beam-gate bias for the beam-control circuits. The output voltage of each filter is approximately –1500 volts.

b. LOW-VOLTAGE SUPPLIES.

The low-voltage positive supply consists of a 5U4G full-wave rectifier followed by a two-section, capacitance-input filter. The 400 volt output of this supply is used to run the deflection amplifiers and all other low-voltage stages except the input cathode-followers,

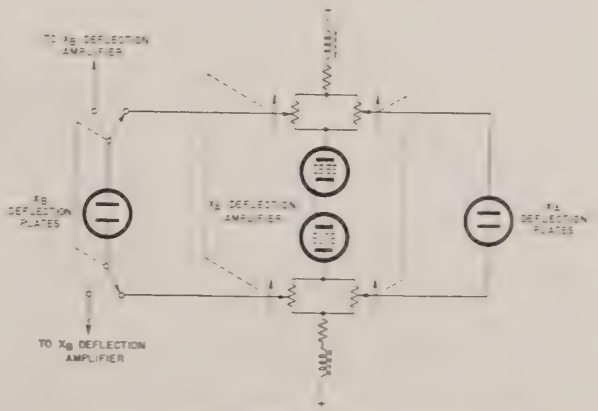


FIGURE 2-9
CIRCUIT TO ELIMINATE TRACKING ERRORS

which are supplied from an electronically regulated supply with an output of 270 volts. This regulated supply also feeds the DC level and position circuits.

A 6X5 used as a half-wave rectifier is used in a low-voltage, negative, regulated supply. The filter is single-section capacitance-input. The output furnishes −150 volts regulated using an OD3/VR150. This supply is used for the input cathode-follower to allow the handling of large signals and as a return for the sweep attenuator to allow the sweep d-c level to be brought to zero. It is also used in the beam gate generator as a bias supply.

SECTION III
OPERATION

1. INSTALLATION OF CATHODE-RAY TUBE.

The Type 279 Dual-beam Cathode-ray Oscillograph is shipped with all tubes in place and ready to operate. In some cases, however, the cathode-ray tube may be packed and shipped separately.

To install the cathode-ray tube, the chassis must first be removed from the cabinet. Remove the two screws holding the chassis to the bottom of the cabinet and the four screws from each side of the front panel and carefully slide the instrument forward until it is clear of the cabinet. Detach the circular ring and calibrated scale from the front panel by removing the four screws which hold them in place.

Insert the cathode-ray tube through the front panel and through the magnetic shield. The flush contacts should be on the left side as viewed from the front of the instrument. Push the tube in far enough so that its base is held by the clamp provided at the rear of the instrument and so that the flush contacts and deflection plate terminals are approximately centered in their respective holes and cut-out. Attach the cathode-ray tube socket to the tube.

CAUTION

The cathode-ray tube should be inserted with great care so as not to damage it. In particular, care should be taken not to strike the deflection plate terminals which might cause breakage. Do not use force at any time. If the tube does not go into the shield and clamp smoothly, look to see whether something is caught.

Connect the long red lead with flush connector to the front flush contact. Connect the other lead with flush connector to the rear flush contact.

Connect the eight deflection plate and two second-anode leads to the cap terminals—the letter on the lead should correspond with the terminal letter located on the magnetic shield opposite each terminal.

Next slide the instrument back into its cabinet all the way so that the safety switch closes, connect the power cord, and turn the instrument on with sweeps on one or both of the axes and no Y-axis signal. If the resulting line is not horizontal, rotate the tube slightly until it is. Then turn the instrument off, disconnect the power cord, and remove the instrument from the cabinet.

Replace the calibrated scale and front ring and move the tube forward so that it just touches the scale. Take care not to rotate the tube in doing this. Then tighten the tube base clamp.

Before replacing the chassis in the cabinet, it is advisable to see that all tubes are properly seated in their sockets and to inspect for any damage that may have occurred in transit.

Slide the instrument back into its cabinet and replace the front panel screws. The instrument is now ready for operation.

2. PRECAUTIONS.

WARNING

OPERATION OF THIS EQUIPMENT INVOLVES THE USE OF VOLTAGES AS HIGH AS 4500 VOLTS, WHICH MAY BE DANGEROUS TO LIFE. OPERATING PERSONNEL MUST AT ALL TIMES OBSERVE ALL SAFETY REGULATIONS. DO NOT CHANGE TUBES OR MAKE ADJUSTMENTS INSIDE THE EQUIPMENT WITH THE HIGH-VOLTAGE SUPPLY ON. DO NOT DEPEND UPON THE SAFETY SWITCH FOR PROTECTION, BUT ALWAYS REMOVE THE POWER CORD FROM THE LINE OUTLET. UNDER CERTAIN CONDITIONS DANGEROUS POTENTIALS MAY EXIST IN THE CIRCUITS WITH POWER CONTROLS IN THE OFF POSITION DUE TO CHARGES RETAINED BY CAPACITORS. TO AVOID SHOCK AND SEVERE BURNS ALWAYS DISCHARGE AND GROUND CIRCUITS PRIOR TO TOUCHING THEM. NEVER SERVICE OR ADJUST THE INSTRUMENT WITHOUT THE PRESENCE OR ASSISTANCE OF ANOTHER PERSON CAPABLE OF RENDERING AID.

a. MAGNETIC AND ELECTRIC FIELDS.

Magnetic and electrostatic shielding has been provided in this instrument. However, operation of the instrument in strong fields such as are found near transmitters, transformers, and power-generating equipment, etc., may introduce spurious deflections.

The magnetic shield in this instrument is made of mu-metal and has been annealed after fabrication by a special process to bring out its optimum shielding characteristics. Orientation of grain structure of the mu-metal, achieved by proper annealing, is important. Rough handling, bending, drilling, machining, etc., after annealing may destroy the magnetic characteristics of the shield and should be avoided.

Electrostatic pick-up may be minimized by the use of shielded input cables and connections and with a good electrical ground on the chassis of the instrument. Spurious magnetic deflections may be eliminated or reduced to an unobjectionable point by removing the instrument from the immediate vicinity of the disturbance; orienting the instrument in the field so that spurious deflection is at a minimum; or in extreme cases, by adding additional magnetic shielding in the form of a large iron or steel container in which the entire instrument may be placed.

b. POWER REGULATION.

The Type 279 is designed to operate at a power line voltage of 115 or 230 volts a.c. at a frequency of 50 to 60 cycles per second. Steady variations of $\pm 10\%$ from the normal operating value will cause little change in the operation of this instrument. Greater changes than this may cause the power supply to operate erratically and the operation of the instrument to become unsatisfactory. Under conditions where power line variations are excessive, the use of a constant voltage transformer placed in the power line to the instrument is recommended. If such a regulator is used, the precautions of paragraph 2a should be observed.

c. SCREEN BURNING.

When a small spot or line of high intensity is allowed to remain stationary on the screen of the cathode-ray tube, the entire energy of the beam is concentrated over a very small area and the power input per unit screen area is high. Under such conditions the screen is susceptible to burning and discoloration. It is well to note that burning of the screen, until carried to excess, will in no way impair the operation of the tube, since the burning is localized to small areas, and the burned area is not completely insensitive.

3. TURNING ON THE INSTRUMENT.

The Du Mont Type 279 Dual-beam Cathode-ray Oscillograph is designed to operate from a 50 to 60 cycle source of power at either 115 or 230 volts rms. The changeover switch which allows operation at either voltage is located at the rear of the instrument (c.f. Figure 3-4). It is accessible without removal of the cabinet. BEFORE CONNECTING THE INSTRUMENT TO ANY POWER SOURCE, SEE THAT THE VOLTAGE CHANGEOVER SWITCH IS IN THE CORRECT POSITION. SERIOUS DAMAGE MAY RESULT IF THIS IS NOT DONE.

To turn the instrument on, it is just necessary to throw the power toggle switch to the ON position.

4. OPERATION OF CONTROLS AND TERMINALS.

Due to the large number of controls and adjustments in this instrument, they will be described as follows:

Table 3-1 and Figure 3-1 describe and show the location of the front panel controls. These are the most used controls and are also discussed in Section 4a.

The controls and terminals on the rear panel are described in Section 4b.

The factory adjustments are described in Section 4c.

a. FRONT PANEL CONTROLS.

(1) *Beam Controls.*

(a) X and Y Position Controls.

These controls determine the rest position of the spot in both horizontal and vertical directions. Markings on the front panel indicate the direction of deflection produced by corresponding rotation of either control.

(b) Intensity and Focus Controls.

The Intensity Control adjusts the bias potential between the grid and cathode of the cathode-ray tube and determines the brightness of the spot. In general, it is desirable to keep the intensity of the trace as low as is consistent with convenience of observation in order to conserve tube life.

A SHARPLY FOCUSED LINE OR SPOT OF SMALL LENGTH OR AREA OF HIGH INTENSITY SHOULD NOT BE PERMITTED TO REMAIN STATIONARY ON THE SCREEN FOR ANY CONSIDERABLE PERIOD. THE ENTIRE ENERGY OF THE BEAM IS THEN CONCENTRATED IN A SMALL AREA AND THE SCREEN MATERIAL IS SUBJECT TO BURNING AND DISCOLORATION.

(Cont'd on Page 14)

FIGURE 3-1

FRONT PANEL OF TYPE 279. THE CAREFULLY PLANNED FRONT-PANEL LAYOUT GROUPS THE CONTROLS OF CHANNEL A AND CHANNEL B. THE VERTICAL CONTROLS FOR EACH CHANNEL ARE ON THE LEFT AND THE HORIZONTAL CONTROLS ARE ON THE RIGHT. CONTROLS COMMON TO BOTH CHANNELS ARE PLACED IN THE CENTER UNDER THE CATHODE-RAY TUBE

TABLE 3-1
TABLE OF OPERATING CONTROLS

Control	Circuit Symbol Channel A Common	Circuit Symbol Channel B	Description	Function
		FRONT PANEL		
Y-position	R19	R156	Potentiometer	Changes vertical position of the trace.
X-position	R78	R100	Potentiometer	Changes horizontal position of the trace.
Intensity	R184	R196	Potentiometer	Changes intensity of the trace.
Focus	R186	R198	Potentiometer	Adjusts focus of the trace.
Sync Selector	S3	S9	Rotary switch	Selects either internal, line frequency, or external sync.
Sweep Recurrence	S5	S11	Rotary switch	Changes from single to continuous sweep operation.
Sync Amplitude	R36	R114	Potentiometer	Changes amplitude and selects phase of sync voltage.

TABLE 3-I — Continued

Control	Circuit Symbol Channel A	Circuit Symbol Channel B	Description	Function
	Common			
Sweep Vernier	R40	R118	Dual potentiometer	Changes sweep frequency continuously for each range.
Sweep Range	S4	S10	Rotary switch	Changes sweep frequency range.
Y-attenuation	S2	S12	Rotary switch	Selects either DC or AC input to amplifier with attenuation ratios of 1:1, 10:1, or 100:1. Also has off position.
Y-amplitude	R17	R154	Potentiometer	Varies amplitude of Y-axis or vertical signal.
X-amplitude	R76	R98	Potentiometer	Varies amplitude of X-axis or horizontal signal.
X-attenuation	S6	S7	Rotary switch	Selects either DC or AC input to amplifier with attenuation ratios of 1:1, 10:1, or 100:1. Also has off position.
Calibrator	S1		Rotary switch	Switches output of calibrator into either Y-amplifier in steps of 0.1, 1, 10, and 100 volts. Also has off position.
Sweep Selector	S8		Rotary switch	Selects individual sweeps or common sweep "A".
Power On	S19		Toggle switch	Completes circuit from power line to instrument.
Ext. Sync Input	J3	J10	Terminal	Connects external sync signals to instrument when Sync Selector is in EXT. position.
Y-input	J1 & J2	J11 & J12	Terminal	Connects signals to input of Y-amplifier.
Sawtooth Test Signal	J4		Terminal	Provides sawtooth test signal from Channel A.
X-input	J5 & J6	J7 & J8	Terminal	Connects signals to input of X-amplifier.
Line Frequency Test Signal	J9		Terminal	Provides line frequency sine wave test signal.
			REAR PANEL	
X-axis Deflection Plate Connections	S14	S16	Toggle switch	Connects either X-amplifier or X-deflection plate terminals to X-deflection plates.
Y-axis Deflection Plate Connections	S13	S15	Toggle switch	Connects either Y-amplifier or deflection plate terminals to Y-deflection plates.
X-axis Deflection Plate Terminals	J16-18	J22-24	Terminal	Connects signals directly to X-deflection plates through coupling capacitors when X-axis deflection plate switch is in "terminal" position.
Y-axis Deflection Plate Terminals	J13-15	J19-21	Terminals	Connects signals directly to Y-deflection plates through coupling capacitors when Y-axis deflection plate switch is in "terminal" position.
Z-axis Input	J25 & J26	J27 & J26	Terminal	Connects intensity modulation signals to cathode of cathode-ray tube through coupling capacitor.
Reg. Voltage Test	J28		Terminal	Allows measurement of regulated voltage.
Safety Switch	S17		Toggle switch	Opens primary power circuit when cabinet is removed.
Line Change Switch	S18		Slide switch	Allows change from 115 V operation to 230 V operation.

The Focus Control adjusts the potential of the first anode of the cathode-ray tube and determines the sharpness of the spot produced on the screen of the cathode-ray tube. It should be adjusted to provide a minimum spot diameter.

(2) *Sweep Controls.*

(a) Sync Selector Switch.

The signal to which the sweep circuit is synchronized is determined by the setting of the Sync Selector switch.

In the EXTERNAL position, the sweep generator may be synchronized by a signal connected to the EXT. SYNC INPUT terminal.

In the LINE position, the sweep generator may be synchronized to the power line frequency.

In the INTERNAL position, the sweep may be synchronized by the signal connected to the Y-amplifier of the same channel.

(b) Sync Amplitude Control.

This control allows adjustment of the sync signal to a value to provide proper synchronization. Either polarity of synchronizing signals may be used determined by the direction in which the control is turned.

Minimum voltages necessary to trigger the SINGLE SWEEP or to synchronize CONTINUOUS SWEEP.

SWEEP VERNIER

	Minimum Setting	*Maximum Setting*
EXTERNAL SYNC	5-7 peak volts	0.3 peak volts
INTERNAL SYNC	Approx. 1 inch deflection	Less than 0.25 inches deflection

The minimum amount of sync voltage required should always be used. Excess sync voltage will cause distortion of the trace.

(c) Sweep Recurrence Switch.

This control sets the sweep generator to either continuous or single sweep operation by changing the bias of the thyratron.

Return trace blanking is provided in the CONTINUOUS position.

Automatic beam blanking except during the sweep interval is provided in the SINGLE position. When in the SINGLE position, repetitive operation may be secured, at a rate determined by the external sync signal used to trigger the sweep.

(d) Sweep Vernier Control.

The Sweep Vernier Control enables adjustment to the exact frequency required within the range of the Sweep Range switch. This control is generally adjusted so that the sweep frequency (without sync) is equal to or slightly less than an integral submultiple of the frequency of the signal under observation.

Sufficient overlap is provided between ranges so that there are no gaps in the sweep frequencies available.

(e) Sweep Range Switch.

The setting of the Sweep Range switch determines the range of sweep frequencies which may be obtained by adjustment of the Sweep Frequency control. The approximate limits of each range are given by the figures on either side of the knob indicator. It is not intended that these figures furnish an exact calibration of the sweep frequencies available. The letter K represents thousand, thus 30 K is 30,000 cycles per second.

The OFF position of the Sweep Range switch renders the sweep inoperative and permits connection of the X-INPUT terminal to the X-amplifier.

(f) Sweep Selector Switch.

The Sweep Selector switch permits the use of Sweep A on both channels in the SWEEP A COMMON position or the use of Sweep A and B individually on their respective channels in the INDIVIDUAL SWEEPS position. In the SWEEP A COMMON position, Sweep B is automatically turned off.

(g) External Sync Input Terminal.

The EXT. SYNC INPUT terminal allows synchronization of the sweep by external signals when the SYNC SELECTOR switch is in the EXTERNAL position as described in section (b).

(h) Sawtooth Test Signal Terminal.

The SAWTOOTH TEST SIGNAL terminal provides a sawtooth test signal derived from Sweep A.

(3) *Amplifier Controls.*

(a) X and Y Attenuation Switches.

The X and Y Attenuation switches provide fixed attenuation ratios of 1:1, 10:1, and 100:1 of the signal applied to the respective input terminals. These maintain a constant input impedance and are of the capacitance-compensated type giving no frequency discrimination.

There are seven positions on each switch. The center position is an OFF position and grounds the input to the amplifier without necessitating re-

moval of signal leads from the input terminals. The three positions marked CAPACITIVE to the left of the OFF position connect the input terminal to the attenuator through a blocking capacitor of 1000 volts rating. The three positions marked CONDUCTIVE to the right of the OFF position connect the input terminal directly to the attenuator to allow DC operation of the amplifier.

The attenuation ratios of 1, 10, and 100 are available on both capacitive and conductive settings of the Attenuator switch, with the attenuation decreasing as the switch is rotated away from the center OFF position.

(b) X and Y Amplitude Controls.

The X and Y Amplitude controls provide continuous attenuation of the signal between the steps provided by the Attenuator switch. An additional 10:1 attenuation ratio is available. Since the gain control introduces practically no frequency discrimination, the response is essentially the same at all settings. It is arranged so that the signal cannot be reduced to zero by means of those controls above, and consequently distortion of the signal cannot be introduced by the oscillograph amplifiers and indicated on the screen. Thus, if the pattern remains on screen, it is a true representation of the input signal.

(c) Calibrator Switch.

The Calibrator switch connects the output to either of the Y-axis amplifiers ahead of the attenuator. It is a nine-position switch. In the center or OFF position, the calibrator circuit is not energized and both Y-axis amplifier input terminals are connected to their respective attenuators and amplifiers.

In the four positions to the left of the center OFF position, the output of the calibrator is fed to the Y_A attenuator and amplifier and the Y_A input terminal disconnected. Thus the signal leads do not have to be removed when the amplifiers are calibrated. The four positions select voltages of 0.1, 1, 10, or 100 volts peak-to-peak, the lowest voltage being adjacent to the center OFF position. Thus the instrument can be calibrated for any gain setting of the Y-amplifier.

The output of the Calibrator is similarly fed to the Y_B attenuator and amplifier in the four positions to the right of the center OFF position.

(d) X and Y Input Terminals.

The X and Y input terminals are connected to the X and Y attenuators and amplifiers.

The Y-input terminals are connected to the attenuator switch through the calibrator switch.

The X-input terminals and attenuators are connected to the amplifiers through the Sweep Range switch.

(4) *Miscellaneous.*

(a) Power Switch.

The Power switch is located at the bottom of the front panel and controls the primary power input to the instrument. This switch is ON in the up position, at which time the pilot light should glow.

(b) Line Frequency Test Signal Terminal.

This terminal furnishes a sinusoidal test signal of power line frequency. It is filtered and protected against short circuits by a current-limiting resistor.

b. REAR PANEL CONTROLS.

(1) *Deflection Plate Teminals and Switches.* (Cf. Figure 3-5).

(a) Deflection Plate Terminals.

There are four sets of three terminals each located on the rear panel to provide signal input directly to the deflection plates without going through the amplifier. In each set of three are two deflection plate connections and one ground connection. The terminals are capacitively coupled with 1000 volt capacitors to the deflection plates through the Deflection Plate switch. Positioning is available at all times. These terminals are located on the rear panel and are accessible through the door in the rear of the instrument. To prevent signals connected to the front panel terminal parts from causing deflection, the appropriate attenuator switch should be set to the OFF postion.

Note

The leads from the plates of the cathode-coupled amplifiers are twisted at the factory to obtain proper peaking. If it is necessary at any time to remove the cathode-ray tube, the twist in the deflection plate leads should not be disturbed.

(b) Deflection Plate Switches.

There is a switch associated with each of the above sets of deflection plate terminals and located immediately below them. This switch connects either the output of the deflection amplifier or the Deflection Plate terminals to the deflection plates.

(2) *Z-axis Input Terminals* (Cf. Figure 3-5).

Also located on the rear panel are three additional terminals. The center one is ground and those on either side provide capacitively-coupled connections to the cathodes of the cathode-ray tube for intensity modulation signals.

FIGURE 3-2
LEFT SIDE VIEW OF THE DU MONT TYPE 279

(3) *Safety Switch* (Cf. Figure 3-4).

Located on the top rear of the chassis is the safety switch. This is a spring-return toggle switch connected in series with the primary power line circuit. It is closed when the instrument is pushed all the way back into its cabinet and opens the primary circuit immediately when the instrument is moved only slightly out of its cabinet, thus turning off the instrument.

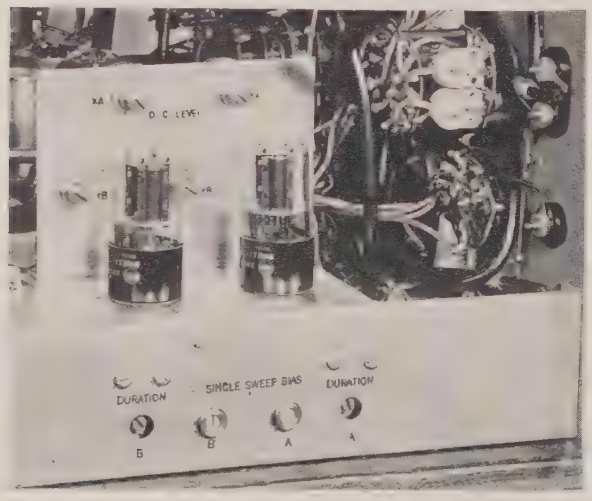


FIGURE 3-3
LEFT SIDE VIEW OF CHASSIS SHOWING LOCATION OF SPECIAL ADJUSTMENTS

(4) *Fuse* (Cf. Figure 3-4).

This instrument is conservatively fused with a 3 ampere fuse so that the fuse will blow before damage is done to the transformer or circuits when overloaded. This fuse is located at the rear of the instrument and is accessible without removal of the instrument from the cabinet.

(5) *Regulated Voltage Test Jack* (Cf. Figure 3-4).

A test jack is located at the rear of the oscillograph and allows measurement of the regulated voltage. This should be +270 volts. Its adjustment is described below.

(6) *Line Voltage Change Switch* (Cf. Figure 3-4).

Also located on the bottom rear of the chassis and accessible without removal of the cabinet is the line voltage change switch. This is a slide switch which allows change from 115 to 230 volt power lines. BEFORE CONNECTING THE INSTRUMENT TO ANY POWER SOURCE, SEE THAT THE CHANGE-OVER SWITCH IS IN THE CORRECT POSITION. SERIOUS DAMAGE MAY RESULT IF THIS IS NOT DONE.

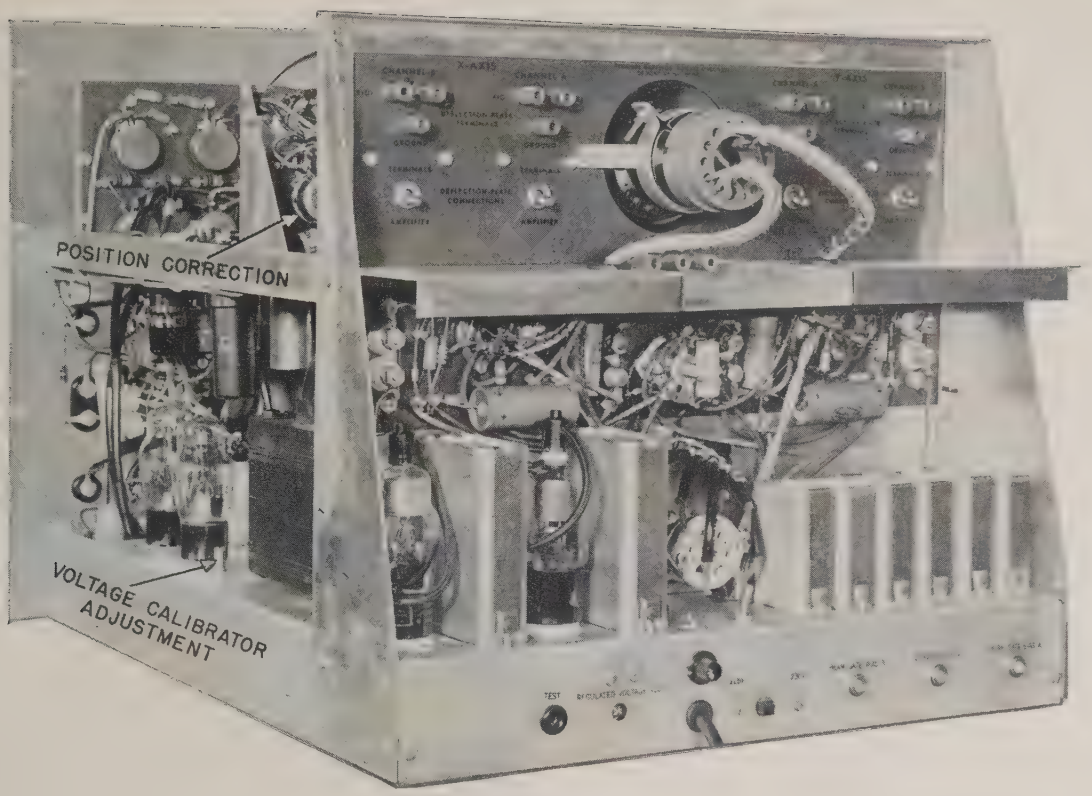


FIGURE 3-4
REAR AND RIGHT SIDE VIEW OF CHASSIS

c. FIXED ADJUSTMENTS.

(1) *Voltage Regulator Adjustment* (Cf. Figure 3-4).

For proper operation of the Type 279 Dual-beam Cathode-ray Oscillograph, it is important that the positive regulated voltage be correct. This has been set at the factory but may change with changes in components during the instrument's life and should be checked occasionally. It should be set at +270 volts at 105 volts line and checked to see that it remains in regulation for changes of ±10% in the normal 115 volt line voltage.

The voltage regulator may be adjusted and measured without removal of the unit from the cabinet. The voltage test jack as described in paragraph 4b (5) above is located at the bottom rear of the unit. The voltage regulator adjustment potentiometer is located next to the test jack and may easily be adjusted with a screwdriver.

(2) *Sensitivity Correction* (Cf. Figure 3-4).

As discussed in Section II, it is necessary to correct for variation in deflection sensitivity of both sets of horizontal deflection plates in order to allow exact superposition of both time-base traces when using common sweep. This is accomplished by adjustment of potentiometer R65. This is located at the bottom rear of the instrument and has been properly adjusted at the factory. It should not need readjustment except for replacement of the cathode-ray tube.

In order to correct for sensitivity, the Sweep Selector switch should be on the SWEEP A COMMON position. Adjust the beam and sweep controls to obtain two sweep lines, one above the other, almost but not touching. The Y-attenuation switches should be in the OFF position. Adjust the Sensitivity Correction potentiometer until the two sweeps are of equal length. The sensitivity adjustment is then correct.

(3) *Position Correction* (Cf. Figure 3-4).

As discussed in paragraph 2 above, besides correcting for sensitivity, it is also necessary to correct for the position of the two spots in order to allow exact superposition of the two time-base traces. This is done by means of potentiometers R85 and R86. These are located on the X_A deflection amplifier bank on the upper-right chassis. It is necessary to remove the instrument from its cabinet to adjust these.

PROPER CAUTION SHOULD BE EXERCISED WHEN MAKING ADJUSTMENTS WITH THE INSTRUMENT OUT OF ITS CABINET. VOLTAGES AS HIGH AS 4500 VOLTS ARE ACCESSIBLE.

With two spots on the screen and with the sensitivity correction properly adjusted, adjust either R85 or R86, or both, until the two spots are one above the other. This adjustment as well as the sensitivity adjustment can then be more closely made by connecting the line frequency test signal to each Y-axis amplifier. Set the Sweep A controls to obtain from 10 to 20 cycles on the screen with about 2 to 4 inches vertical deflection on each Y-axis. Adjust the Y-position and Y-amplitude controls so that the two traces coincide. Use as low an INTENSITY control setting with as fine a focus as it is possible to obtain. If the sensitivity and position correction controls are properly adjusted, the two traces will appear as one. If not, readjust these controls as necessary.

(4) *D.C. Level Controls* (Cf. Figures 3-2 and 3-3).

Since the amplifiers of the Type 279 are DC amplifiers, the respective amplitude controls are connected directly to the cathodes of the cathode-followers, and hence the d-c voltage on the cathodes appears at the top of the amplitude control. If the bottom of the amplitude control were connected to ground, a portion of this d-c voltage would appear at the grid of the amplifier along with the signal depending on the setting of the amplitude control. The result would be a d-c shift or change in position of the signal with change in gain control. In order to eliminate this, it is necessary that the bottom of the amplitude control have the same d-c voltage setting as the top (no d-c voltage drop across the amplitude control). Since this voltage may change due to tube aging or to difference in different tubes, an adjustment is provided to set the bottom of the control to the same voltage as the top.

To adjust one of the d-c level controls, turn the corresponding attenuation switch to the OFF position. Then adjust the d-c level control so that there is no shift in the spot or line on the screen as the amplitude control is varied from minimum to maximum. These four controls for the four amplifiers are located on a bracket on the left front of the chassis, and they are available without removing the instrument from its cabinet. These controls may be adjusted through the top four holes in the left side of the cabinet as shown in Figures 3-2 and 3-3.

(5) *X and Y Amplifier Attenuators.*

The input attenuators are of the stepped, R-C compensated type where the ratio of resistance for each step must be equal to the inverse ratio of capacitance to avoid frequency discrimination. In order to make the adjustment perfect without very precise components, part of the capacitance divider is variable. There are two trimmer capacitors on each attenuation switch; one for the 10:1 step, and one for the 100:1 step.

The adjustment should be made with a 5000 cycle square wave and is correct when the square wave is passed without distortion. In particular, the leading edge should be looked at to have neither overshoot nor undershoot, either of which indicates incorrect adjustment.

(6) *Single Sweep Bias.*

This control (one for each sweep) is located on the left side of the chassis and consists of a potentiometer used as a variable resistance to adjust the bias (and hence conduction potential) of the single sweep diode. These controls are also available without removing the instrument from its cabinet, see Figures 3-2 and 3-3.

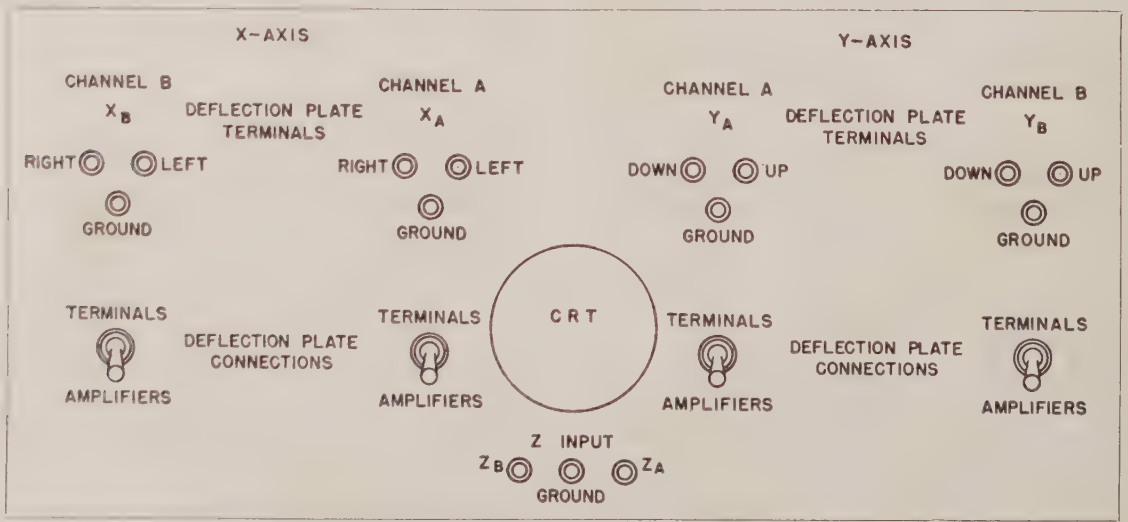


FIGURE 3-5
REAR PANEL OF DU MONT TYPE 279

To adjust the single sweep, first set the appropriate Beam Gate Bias control so that the beam is always on (fully clockwise for Beam A, fully counterclockwise for Beam B). The intensity control should be set higher than for normal setting on continuous sweep.

With the sweep controls set to maximum frequency and the SWEEP RECURRENCE switch set to SINGLE, adjust the single-sweep bias control so that the sweep is just prevented from firing with the SYNC AMPLITUDE control at zero.

Check the setting by advancing the Sync Amplitude control. SYNC SELECTOR should be in the LINE position. The sweep should trigger. Check the operation of the single sweep at minimum setting of the Sweep Vernier and at low frequencies. Check the operation of the continuous sweep to make sure that it operates correctly. If it is not possible to set the single sweep without causing the continuous sweep to stop, the thyratron should be changed.

(7) *Beam Gate Bias and Single Sweep Duration Controls* (Cf. Figure 3-4).

After the single sweep bias has been adjusted, the Beam Gate Bias control should be adjusted. With no sync on and with the Sweep Recurrence switch set to SINGLE, adjust the Beam Gate Bias Control until the beam cuts off. Check this at both minimum and maximum settings of the Sweep Vernier control.

Now rotate the Single Sweep Duration Control. It should be possible to turn the beam on and off with this control. If it is not possible to turn the beam on, the Beam Gate Bias control has been set too far and should be readjusted.

Adjust the Single Sweep Duration control so that the beam just cuts off. Now with the Sweep at its lowest frequency and with a test lead connected from the Line Frequency Test Signal Terminal to the Y-input Terminal, set the Y-attenuator to 1:1 and the Y-Gain Control to 30. Turn the Sync Selector to INTERNAL and the Sync Amplitude full on. A line should now be observed moving slowly across the screen. Turn the Sync Amplitude to 0. The line should disappear and nothing should appear on the screen. If a fixed line appears readjustment of the Single Sweep Duration and/or Beam Gate Bias Controls will be necessary.

The Single Sweep Duration (and Beam Gate Bias) control should be adjusted so that the beam is on only when sync signals appear and blanks out at the end of the active sweep time. It should be adjusted so that at least 60% to 70% of the total available sweep time is used and the remaining non-linear portion is blanked out. Particularly at the lowest sweep frequency, it should be possible to trigger the sweep only once (for example by momentarily touching the test signal lead to the input terminal), and the spot should extinguish at the end of its travel. In addition, the controls should be so set that the sweeps expand fairly well symmetrically with increase in the X amplitude control.

With extreme care taken in setting these controls, good, stable triggering of the single sweep will be possible at full sync gain and will remain so independent of variation in the Y-amplitude control. When this does not occur or is too difficult to achieve, use the smallest sync amplitude control setting possible for stable synchronization, especially at low input signal settings (high gain).

In particular, the adjustment of the Single Sweep Duration control for Channel A and both Beam Gate Bias controls should be made so that the sweeps are equal and move together in the common sweep position, especially at the lowest sweep frequency. These controls have been set carefully at the factory and should not, in general, have to be readjusted. Care in their adjustment and understanding the circuit will help in achieving maximum performance. The Single Sweep Duration controls are located on the left side of the instrument, while the Beam Gate Bias controls are at the rear. All these controls are accessible without removing the instrument from its cabinet, see Figure 3-4.

(8) *Beam Gate and Single Sweep Trimmers.*

The Single Sweep Trimmers are located on the front sections of the respective Sweep Recurrence switches, while the Beam Gate trimmers are located on the rear panel.

There are frequency compensation trimmers in attenuator circuits and should not need readjustment. They are adjusted to prevent spurious "tails" from appearing on the single sweep at the leading edge.

SECTION IV
MAINTENANCE

1. GENERAL.

The components used in the Type 279 Dual-beam Cathode-ray Oscillograph have been selected and tested to provide long, trouble-free operation. However, it should be recognized that trouble may occur at some time during the life of the instrument, and the following information is intended to be useful in the location and correction of such trouble.

2. ADJUSTMENTS.

If the instrument is operating, there are few adjustments that need be made in order that optimum performance be obtained. The table of operating characteristics along with the discussion of controls in Section III should give enough information to allow proper adjustment of the instrument.

3. CIRCUIT VOLTAGES.

A table of operating voltages is given in Table 4-1. These figures are taken with a 20,000 ohm/volt meter.

WARNING

DANGEROUS POTENTIALS AS HIGH AS 4500 VOLTS ARE IN THIS INSTRUMENT. SINCE THESE POTENTIALS MAY BE DANGEROUS TO HUMAN LIFE, THEY SHOULD BE TREATED WITH PROPER CAUTION.

4. WARRANTY.

Du Mont Instruments.

All instruments manufactured by Allen B. Du Mont Laboratories, Inc., are guaranteed to equal or exceed all specifications for that particular instrument as published by the company. They are further guaranteed against defective workmanship and materials, with the exception of the cathode-ray tube, for a period of one year from date of sale, and we will promptly repair the instrument or replace it, at our discretion, at any time within the guarantee period should any defect develop from these causes or the instrument be not as represented, upon our inspection of the equipment.

In order that this guarantee be effective, it is necessary that the enclosed guarantee card be properly filled out and mailed to the factory immediately upon receipt of the equipment. Complete information should be given, since a record of every instrument is maintained at our office. This record constitutes our source of information when any correspondence is necessary. Both the *type number and the serial number* of the instrument must be given on this card in order that the information be complete.

Du Mont Cathode-ray Tubes.

All industrial cathode-ray tubes manufactured and sold by Allen B. Du Mont Laboratories are guaranteed for a life of 1,000 hours or for six months, depending upon which expires first. The only exceptions to this guarantee are burned-out heaters and broken glass. Cathode-ray tubes will be promptly replaced within the guarantee period if, upon our inspection, the tube has failed within less than its normal expected life.

In order that this guarantee be effective, it is necessary that the enclosed guarantee card be properly filled out and mailed to the factory immediately upon receipt of the equipment. Complete information should be given in order that the records which we maintain on your particular tube will be accurate. When correspondence is necessary, both *type number and serial number* of the tube should be mentioned. The serial number of Du Mont cathode-ray tubes will be found on the glass stem of the electron gun.

5. SERVICE.

Du Mont equipment is designed and manufactured in accordance with the best practices of modern engineering, and it is fully inspected before it leaves our factory. Under normal operation it may be expected to give long, trouble-free service. In order to insure factory service and proper consideration within the guarantee period, the enclosed guarantee card should be properly filled out and mailed to the factory immediately upon receipt of the equipment.

In many cases, equipment has been returned to us, without authorization, and without any need for our examination, resulting in unnecessary shipping costs. In the event that you feel you have not received satisfactory operation from this equipment, you should immediately contact our Instrument Service Department, mentioning the *type number and serial number,* completely outlining all characteristics of the failure, and describing the method in which the equipment has been used.

It is important that such information be given, since much time often can be saved when all operating con-

(Cont'd on Page 22)

TABLE 4-1
TABLE OF NOMINAL CIRCUIT VOLTAGES

Notes: 1. Voltages as indicated on properly adjusted units.
2. Measurements made with 20,000 ohm/volt meter.
3. Tests should be made with continuous sweep operating @ approximately 50 cps and all other controls off unless otherwise noted.
4. All voltages are DC from indicated pins to ground unless otherwise noted.

Tube	Pin	Remarks	Value
VI	3		0
V2	5		0
V2	8	Sweep off	11
V3	4	With sweep off, adjust position voltage to V2 pin 8 value. Spot should be centered vertically	11
V3	5	Sweep off—center spot	16
V3	6		130
V3	8		224
V4	4		11
V4	8		224
V5	1		15
V5	2		139
V5	3		25
V5	4	Sweep recurrence—continuous	88
V5	4	Sweep recurrence—single	94
V5	5	Sweep recurrence—continuous	39
V5	5	Sweep recurrence—single	93
V6	5		0
V6	8	Sweep recurrence—continuous (Max. vernier)	6
V6	8	Sweep recurrence—continuous (Min. vernier)	5
V6	8	Sweep recurrence—single	9
V7	3	Sweep recurrence—continuous (Max. vernier)	50
V7	3	Sweep recurrence—continuous (Min. vernier)	45
V7	3	Sweep recurrence—single	80
Junction R45 & R46		Sweep recurrence—continuous (Max. vernier)	(approx.) 0
Junction R45 & R46		Sweep recurrence—continuous (Min. vernier)	(approx.) 0
Junction R45 & R46		Sweep recurrence—single	2
Center arm of R40B		Sweep recurrence—single (Max. vernier) Sync on	66
Center arm of R40B		Sweep recurrence—single (Min. vernier) Sync on	52
V7	4	Sweep recurrence—single (Max. vernier) Sync on	–4
V7	4	Sweep recurrence—single (Min. vernier) Sync on	–5
V7	5	Sweep recurrence—single Sync off	135
V7	5	Sweep recurrence—single Sync on	135
V8*	1	Sweep recurrence—single Sync off—from (–) side of C25	35
V8*	2	Sweep recurrence—single Sync off—from (–) side of C25	65
V8*	3	Sweep recurrence—single Sync off—from (–) side of C25	35
V8*	4	Sweep recurrence—single Sync off—from (–) side of C25	25
V8*	5	Sweep recurrence—single Sync off—from (–) side of C25	136
V9	5	Sweep off	0
V9	8	Sweep off	11
V10	4	Sweep off. Set position voltage to V9 pin 8 value. Spot should be centered horizontally.	11
V10	5	Sweep off—center spot	16
V10	6	Sweep off	130
V10	8	Sweep off	224
V11	4	Sweep off	11
V11	8	Sweep off	224
V12	5	Sweep off	0
V12	8	Sweep off	11
V13	4	Sweep off. Set position voltage to V12 pin 8 value. Spot should be centered horizontally.	11
V13	5	Sweep off—center spot	16
V13	6	Sweep off	130
V13	8	Sweep off	224
V14	4	Sweep off	11
V14	8	Sweep off	224
V15	1		15
V15	2		139
V15	3		25
V15	4	Sweep recurrence—continuous	88
V15	4	Sweep recurrence—single	94
V15	5	Sweep recurrence—continuous	39
V15	5	Sweep recurrence—single	93
V16	5		0
V16	8	Sweep recurrence—continuous (Max. vernier)	6
V16	8	Sweep recurrence—continuous (Min. vernier)	5
V16	8	Sweep recurrence—single	9
V17	3	Sweep recurrence—continuous (Max. vernier)	50
V17	3	Sweep recurrence—continuous (Min. vernier)	45
V17	3	Sweep recurrence—single	80
Junction R123 & R124		Sweep recurrence—continuous (Max. vernier)	(approx.) 0
Junction R123 & R124		Sweep recurrence—continuous (Min. vernier)	(approx.) 0
Junction R123 & R124		Sweep recurrence—single	2
Center Arm of R118B		Sweep recurrence—single (Max. vernier) Sync on	66
Center Arm of R118B		Sweep recurrence—single (Min. vernier) Sync on	52
V17	4	Sweep recurrence—single (Max. vernier) Sync on	–4
V17	4	Sweep recurrence—single (Min. vernier) Sync on	–5
V17	5	Sweep recurrence—single Sync off	135
V17	5	Sweep recurrence—single Sync on	135
V18*	1	Sweep recurrence—single Sync off—from (–) side of C63	35
V18*	2	Sweep recurrence—single Sync off—from (–) side of C63	65

* **WARNING:—Use caution in measuring these voltages since the meter will be approximately 1500 volts from ground potential.**

TABLE 4-I — Continued

Tube	Pin	Remarks	Value
V18*	3	Sweep recurrence—single Sync off—from (–) side of C63	35
V18*	4	Sweep recurrence—single Sync off—from (–) side of C63	25
V18*	5	Sweep recurrence—single Sync off—from (–) side of C63	136
V19	5	Sweep off	0
V19	8	Sweep off	11
V20	4	Sweep off. Set position voltage to V19 pin 8 value. Spot should be centered vertically.	11
V20	5	Sweep off—center spot	16
V20	6	Sweep off	130
V20	8	Sweep off	224
V21	4	Sweep off	11
V21	8	Sweep off	224
V22	2		–1400
V22	3		–1470
V22	5		–890
V22	9		–1400
V22	10		–1470
V22	12		–890
Junction R174 & 175			210
V23	2		480
V23	4	AC	430
V23	6	AC	430
V24	3		410
V24	5		265
V24	8		270
V25	4		144
V25	5		150
V28	5		–250
V28	8	AC	200
V29	4	AC	1480
V30	Cap	AC	2000

* **WARNING:—Use caution in measuring these voltages since the meter will be approximately 1500 volts from ground potential.**

ditions are known. With such information, we often are able to make decisions and suggestions which will avoid returning it to our plant. The foregoing applies also to Du Mont cathode-ray tubes.

All equipment returned to our plant should be shipped, carefully packed, via express prepaid. Cathode-ray tubes larger than five inches screen diameter should be shipped separately and should not be left mounted in their socket within the instrument. In addition, all equipment should be properly identified either by a packing slip or, preferably, by a suitable tag affixed to it. Unidentified equipment which has been returned to us is a serious source of needless errors and delays.

All correspondence pertaining to the servicing of Du Mont Instruments should be addressed to Allen B. Du Mont Laboratories, Inc., Instrument Service Department, 1000 Main Avenue, Clifton, N. J.

6. REPLACEMENT PARTS.

When ordering replacement parts, always give the type number and serial number of the instrument and refer to the part by its symbol designation and its description on the schematic.

7. SPECIFICATIONS.

The right is reserved to change the specifications of any equipment, without notice, at any time. This right shall not incur any liability to Allen B. Du Mont Laboratories, Inc., to change equipment previously sold, or to supply new equipment in accordance with earlier specifications.

THE DU MONT "OSCILLOGRAPHER"

The Du Mont "Oscillographer," a quarterly publication, is published regularly by the Allen B. Du Mont Laboratories. It is sent free of charge to engineers, research workers, and those engaged in the use and application of cathode-ray equipment. When sending requests for subscriptions and address-change notice, please supply the following: name, company name, company address, type of business, and title of individual.

ALLEN B DU MONT LABORATORIES, INC.,
INSTRUMENT DIVISION
1000 Main Avenue, Clifton, N. J.
U.S.A.

PATENT NOTICE

Manufactured under one or more of the following U. S. Patents:

1,844,117	1,960,333	1,999,407	2,000,014	2,014,106
2,067,382	2,082,327	2,085,576	2,087,280	2,098,231
2,153,800	2,157,749	2,162,009	2,163,256	2,164,176
2,185,705	2,186,634	2,186,635	2,190,020	RE. 21,326
2,201,309	2,207,048	2,208,254	2,209,507	2,221,398
2,225,099	2,227,822	2,229,556	2,245,409	2,245,428
2,249,942	2,249,943	2,269,115	2,269,129	2,280,700
2,280,738	2,290,592	2,297,742	2,297,752	2,299,471
2,299,510	2,315,848	2,319,691	2,321,149	2,328,259
2,331,401	2,337,980	2,338,336	2,338,646	2,343,630
2,345,549	2,346,509	2,347,933	2,355,363	2,356,733
2,364,687	2,365,476	2,372,455	2,372,901	2,373,114
2,379,488	2,384,931	2,389,025	2,391,082	2,391,090
2,391,273	DES. 143,796	2,396,014	2,398,535	2,398,959
2,404,185	2,408,193	2,409,419	2,410,920	2,414,319
2,414,634	2,419,118	2,419,177	2,423,362	2,426,419
2,429,824	2,435,564	2,435,680	2,436,265	2,437,173
2,438,668	2,438,706	2,438,717	2,439,186	2,440,597
2,441,334	2,442,138	2,442,264	2,442,545	

Other Patents Pending

ALLEN B. DU MONT LABORATORIES, INC.
CLIFTON, N. J., U. S. A.

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Additional copies of this manual may be secured at a cost of fifty cents each or five dollars per dozen copies; postpaid in the United States of America only.